

# PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventors: HANS HELMER KRAMER and GEORG GLEISSBERG



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## COMPLETE SPECIFICATION

### Improvements in or relating to a Method for the Regulation of the Charge Level and of the Rate of Throughput of Mills, especially Ball Mills

We, INSTITUT FÜR WARMETECHNIK UND AUTOMATISIERUNG DER SILIKATHUTTEN-INDUSTRIE (W.T.I.), of Am alten Kalkwerk, Jena-Burgau, Germany, a Nationalised Corporation organised under the laws of Eastern Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

It is known that ball mills operate most favourably when a specific degree of charge of the grist corresponds to a specific acoustic pressure of the grinding noise radiating from the mill. This circumstance is exploited for regulating the charge level in that the acoustic pressure measured by a microphone is employed as a control impulse, which controls through an amplifier and a regulator the speed of revolution of the motor for the conveyor member of the grist.

It has been proposed for a mixture of frequencies dependent upon the grinding noise, to be split up by a frequency filter into a high and a low frequency range and after rectification of both ranges a control voltage independent of the sound volume, derived from the ratio of the two.

It has proved in practice that in the case of many ball mills with specific grists the frequency of signals derived from the noise is of major importance, but is only of slight importance in other cases where the amplitude of the signals is of major importance. Satisfactory functioning is therefore never guaranteed from the outset, as in each case a process of the described type is bound to fail.

The invention relates to a process for the regulation of the charge level and the rate

of throughput of mills, especially ball mills, applying the grinding noise as a source for a control signal in which, however, in contrast to the known state of the technique both the sound volume component and the frequency component are made use of for purposes of regulation.

The invention consists in a method for the regulation of the charge level and the rate of throughput of mills, especially ball mills, using the grinding noise as a source for a control signal, wherein a regulator serving for controlling a charging arrangement for the mill is controlled by the rectified output of an amplifier the input of which is fed with the said control signal, the frequency characteristic of the amplifier being such that the variation of its relative output voltage corresponds after rectification to the sum of the relative frequency and amplitude variations of the noise of the mill.

The desired frequency characteristic is obtained through resistance-capacitance elements, resistance-inductance elements or through oscillator circuits. By suitable dimensioning of these elements it is further possible to suppress specific ranges of the noise frequency spectrum. Suppression of irrelevant amplitude ranges may be effected by use of non-linear resistors and/or by making use of the non-linearity of valves used in the amplifier.

In order to make the invention clearly understood, reference will now be made to the accompanying drawings which are given by way of example and in which:—

Fig. 1 is a diagram of a ball mill having a charge level regulating arrangement; and

Fig. 2 is a graph illustrating a frequency characteristic.

The grinding noise of a mill 7 is picked up by microphone 1 and passed to an amplifier 2, which is so constructed that the noise of the mill will be measured both in terms of frequency and amplitude. The output voltage of the amplifier is rectified by a rectifier 3 and passed to a regulator 4 which serves, by means of a controlling element 5, for controlling the supply of grist to the mill 7, the supply taking place by means of an endless conveyor device 6 so that the mill is operated at an optimum noise level. The desired operation of the mill is obtained with a frequency characteristic according to Fig. 2. A rise in the frequency  $f$  of the input voltage  $U_e$  corresponds to an increase of the output voltage  $U_a$  of the amplifier 2. However, an increase of the output voltage occurs also when the amplitude of the input voltage rises. When variation of the charge level of the mill is related for example to a simultaneous variation of the frequency  $f$  to  $\Delta f$  and of the amplitude of the noise of the mill  $U_e$  to  $\Delta U_e$ , the relative variation of

the output voltage of the amplifier  $\frac{\Delta U_a}{U_a}$

corresponds approximately to

$$\frac{\Delta U_a}{U_a} \approx \frac{\Delta U_e}{U_e} + \frac{\Delta f}{f}$$

The relative variation of the output voltage corresponds therefore approximately to the sum of the relative variations of frequency and amplitude of the milling noise.

#### WHAT WE CLAIM IS:—

1. A method for the regulation of the charge level and the rate of throughput of mills, especially ball mills, using the grinding noise as a source for a control signal, wherein a regulator serving for controlling a charging arrangement for the mill is controlled by the rectified output of an amplifier the input of which is fed with the said control signal, the frequency characteristic of the amplifier being such that the variation of its relative output voltage corresponds after rectification to the sum of the relative frequency and amplitude variations of the noise of the mill.

2. A method as claimed in Claim 1, wherein by the use of resistance-capacitance elements or resistance-inductance elements such a selectivity curve of the amplifier is obtained that certain irrelevant ranges of the noise frequency spectrum are suppressed.

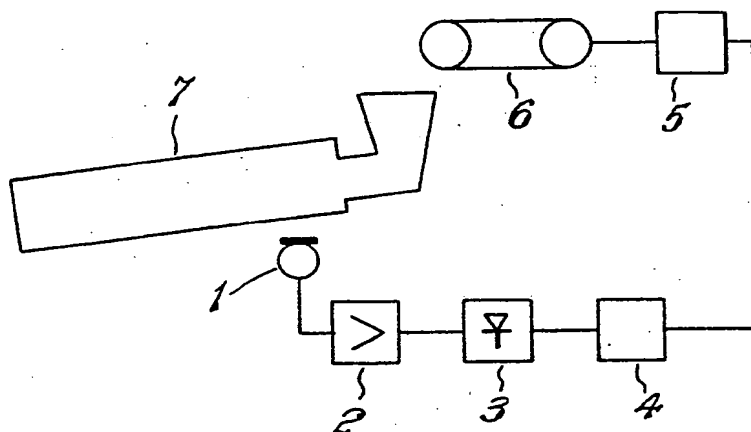
3. A method as claimed in Claim 1 or 2, wherein by the use of non-linear resistances in the amplifier or by utilising non-linearity of valves of the amplifier such a selectivity curve of the amplifier is obtained that certain irrelevant ranges of amplitude of the noise signal are suppressed.

4. A method for the regulation of the charge level and the rate of throughput of mills, substantially as hereinbefore described with reference to the accompanying drawings.

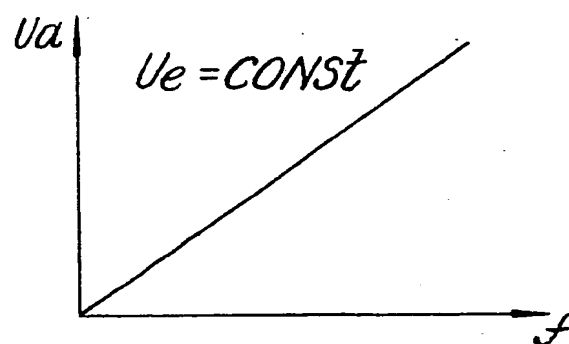
H. A. L. VENNER,

Chartered Patent Agent,

1, Great James Street, Bedford Row,  
London, W.C.1,  
Agent for the Applicants.



*Fig. 1*



*Fig. 2*